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Chapter 3 TEST starts HERE!

Atoms:

Democritus ≈ 300 B.C. - Philosopher thinking about the world around him and trying to explain it.
Aristotle - ancient history of original thoughts
Democritys - coined the term "atom"
atomos - indivisable particle
300 B.C. - 4 elements - Earth, Wind, Air, Fire

1789 - Laviosier - Father of Chemistry
Proved that oxygen was needed for fire
oxygen was needed to support Combustion
Proved the conservation of Matter.
Was a scientist in his free time,
science was a hobby for Laviosier.
He was a tax collector by occupation

John Dalton - British school teacher
≈1803
Law of Multiple Proportitions
Elements can combine in different Small Whole # Ratios

CO_2 1:2 } different whole numbe
CO 1:1 } ratios

Atomic Theory on how atoms work
Dalton's biggest claim to fame.

(over →)

Dalton's Atomic Theory

1) Matter is Composed of tiny particles (Atoms)

2) atoms of the same element have the same Chemical and physical properties.

3) atoms of different elements have different Chemical and physical properties.

4) Atoms can not be created, subdivided nor destroyed.

5) Atoms combine in whole number ratios

6) In reactions, atoms separate and rearrange to form new Compounds.

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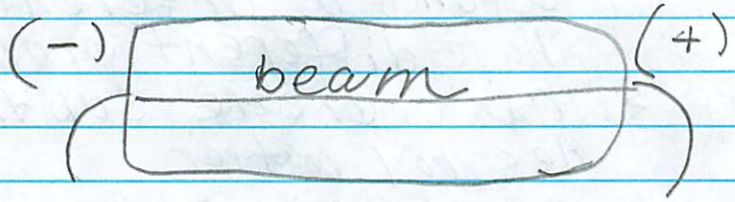
Dalton- Atomic Theory
1. all Matter made of tiny particles
2. •atoms of same element have the same properties
•atoms of different elements have different properties
3. Can't create, subdivide, destroy matter
4. Combines in small, whole ratios
5. In reactions, atoms rearrange and form new compounds.

Present Day Changes to Atomic Theory
- nuclear fission-destroys atoms
- can subdivide atoms into protons, neutons, elections
- elements on the bottom of Periodic Table are man made.
- Isotopes: same element with different masses which give them different properties, example, C^{12}, C^{13}, C^{14} all are the same element, Carbon, but C^{14} is radio active

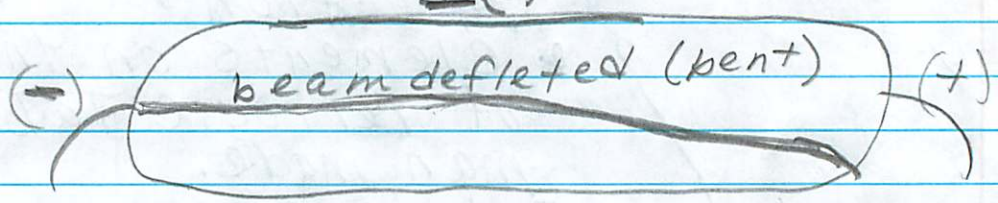
(over ⇒)

1897- J. J. Thompson - worked with Cathode Ray Tubes (CRT), a sealed glass tube with a gas at low pressure, when an electric current passes through the tube, see a beam of light

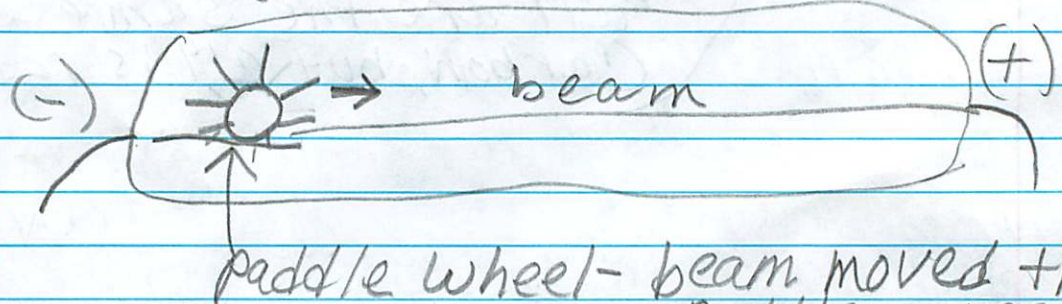


CRT

by placing a negative electrode near the beam, the beam deflected away from the negative charge



Beam deflects away from negative charge; Beam must be negative also.



paddle wheel - beam moved the paddle wheel.

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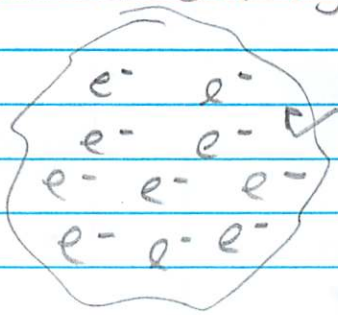
In order to move the paddle wheel, the beam must be made of matter which is pushing the paddle wheel. just like water or air push on water wheels or wind wheels
Thompson discovered the electron, which were pushing on the paddle wheel inside the CRT.
Thompson wins Noble Prize for discovering electrons.
Thompson starts thinking about how the atom works, develops
* Plum Pudding Model of the Atom
electrons, -e, are floating in a diffuse cloud of positive charge



10^{-31} Kg - e^-

1908 Rutherford - Gold Foil experiment testing Thompson's Model by Shooting (+) particles at Gold Foil.

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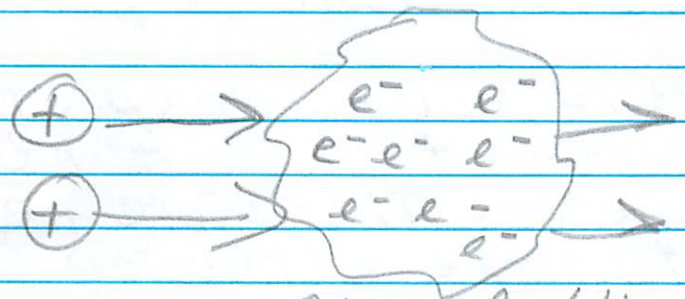
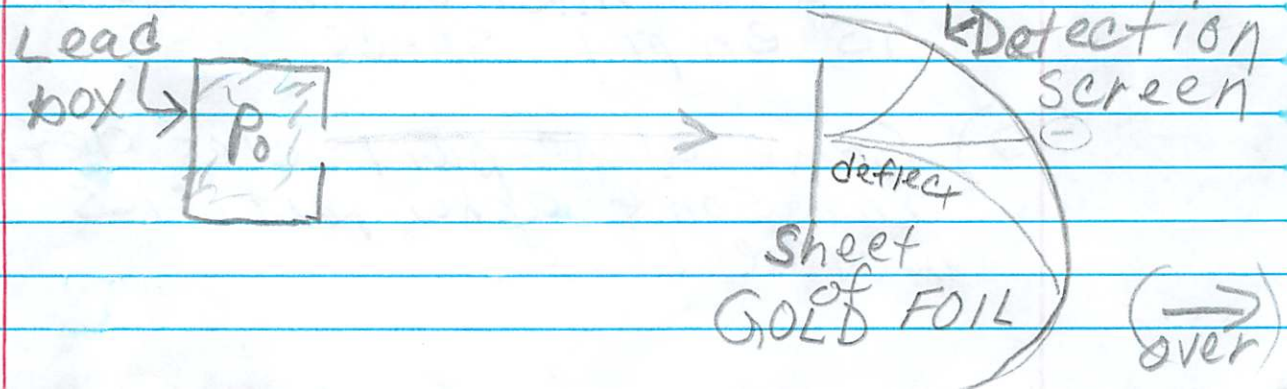
Rutherford - Parts of the atom
Rutherford - Gold Foil Experiment tested Thompson's model of the atom by firing positive (+) particles at Gold Foil. In theory, based on Thompson's Plum Pudding Model, the positive (+) particles should go right through



Plum Pudding Mode

Used radio-active [Po] which are positive alpha-particles α (+)
↖ Lead box

Put a small hole in the Lead box to control the aim of (+) alpha particles from the radio-active plutonium, Po.



What did Rutherford see?

1) Most of the (+) particles passed through the GOLD foil.
   ↳ therefore, Atom is mostly empty space

2) Some particles deflect at an angle as they pass through the foil.
   ↳ therefore, something in the atom is positive.

3) Rutherford did not expect this deflection, but he did see it. Therefore, he expanded the detection screen in front of the foil, and a few particles bounced back, something dense and positive was in the gold atom. Rutherford discovered the nucleus. ⇒ Noble Prize

1) Most of the alpha particles pass right through gold foil because most of the atom is empty space.

2) Some alpha particles deflect and some apha particles bounce back.

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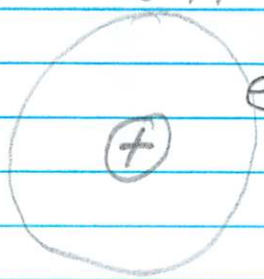
Rutherford's Solar System Model of the atom

Electrons FLOAT AROUND the NUCLEUS



Three Parts of the Atom

1) Proton - (P) } in the nucleus, give the
2) Neutron - (N) } atom its mass
3) Electron - (e^-) - outside is the electron cloud

All mass of the atom comes from the nucleus.

The e^- cloud gives the atom its volume.

Relative Mass: Atomic Mass Unit: amu

1 amu = 1.66×10^{-24} g.

1 amu = Proton } Mass
1 amu = Neutron } Relative to
0 amu = electron } each other.

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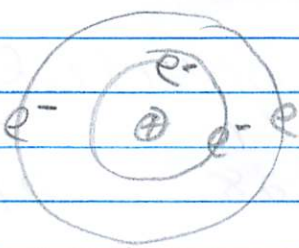
Models of the Atom

Dalton - Atom solid sphere

Thompson - Plum Pudding Model, e⁻ floating in a pudding of ⊕ charge

Rutherford - Nuclear Model, dense ⊕ center of the atom
Found the nucleus, then proton

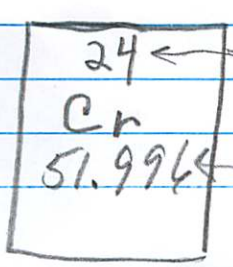
Solar System Model - Chadwick - found neutrons



Relative Mass - Parts of the Atom

	Mass	Charge
Protons - nucleus,	1 amu,	⊕
Neutrons - nucleus,	1 amu,	0
Electrons - outer cloud,	0,	⊖

Counting p, n, e⁻ - need Periodic Table



← Atomic Number - how many protons

← Average Atomic Mass
↳ Round off to mass #, p+n

	p	n	e^-
Cr	24	52-24=28	24

↑ at mass ↑ #p ↑ #n

at mass - #p = #n

of e^- = #p because atoms are neutral

$\#e^- = \#p$

Atoms are neutral

Ions - are charged because # of e^- varies

Cations - positive ions

	p	n	e^-
Cr^{3+}	24	28	21 (lose 3 e^-)

Anions - negative ions have more e^- than p

	p	n	e^-
S^{2-}	16	32-16=(16)	18

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Isotopes - Same element but have different masses. Have different numbers of nuetrons. The number of protons does not change.

Copper Type	Actual mass (amu)	% Abundance
$^{63}_{29}Cu$	62.93	69.17 %
$^{65}_{29}Cu$	64.93	30.83%

Averages on Periodic Table reflect which isotope is more abundant in nature.
most of the Copper in the world is Copper-63 and the average mass on the periodic Table accounts for this.

For Example, there are three kinds of Carbon: $^{12}_{6}C$
$^{13}_{6}C$
$^{14}_{6}C$ - radioactive, decays

(over →)

$$\text{Average Mass} = \left(\text{mass Isotope 1}\right)\left(\%\ 1\right) + \left(\text{Mass Isotope 2}\right)\left(\%\ 2\right)$$

$$+ \ldots {}^{65}_{29}Cu$$

$$Cu\ \text{Avg. Mass} = (62.93\,amu)(.6917) + (64.93)(.308$$

$$= 63.55\ amu$$

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Chapter HW due on Thurs.

Stability of Isotopes

Different version of the same element, # of protons DOES NOT change.

the # of neutrons changes ⇒ different masses.

Radioactive Isotopes

the higher the mass, the greater the number of neutrons

As an element becomes radioactive, the nucleus becomes unstable and breaks down, that is, breaks down.

When the nucleus decays, particles are ejected.

Three Kinds of Radioactive Emissions:

- Alpha particle, α-particle is a Helium nucleus;

mass → 4
at. # → 2 | He

- Beta particle, is an electron - ie $^{0}_{-1}e$

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Three Kinds of Radioactivity:

- Alpha α particle, Helium nucleus, ejects 2 neutrons + 2 protons

mass → $^{4}_{2}He$ ← At #

mass = 2n + 2p

at # = 2 protons

- Beta β particle, ejects an electron $^{0}_{-1}e^{-}$, blocked by plexiglass

- Gamma Ray - High energy light very harmful, dangerous, blocked by concrete, lead.

Nuclear Equations of Nuclear Decay (Transmutations) - an element is losing protons, changes into another element.

- Alpha α Decay - Blocked by paper

$$^{218}_{84}Po \longrightarrow {}^{214}_{82}Pb + {}^{4}_{2}He$$

$$^{230}_{90}Th \longrightarrow {}^{226}_{88}Ra + {}^{4}_{2}He$$

Parent Isotopes, starting isotope. → Daughter Isotopes, have a smaller at. #

(over →)

- Beta decay - an electron is ejected.
  ↳ is caused by a neutron decay

$$^{1}_{0}n \rightarrow {}^{0}_{-1}e^{-} + {}^{1}_{+1}p$$ Atomic # goes up.

Daughter Isotopes have a higher at. #.

$$^{32}_{15}P \longrightarrow {}^{0}_{-1}e^{-} + {}^{32}_{16}S$$

$$^{210}_{83}Bi \longrightarrow {}^{0}_{-1}e^{-} + {}^{210}_{84}Po$$

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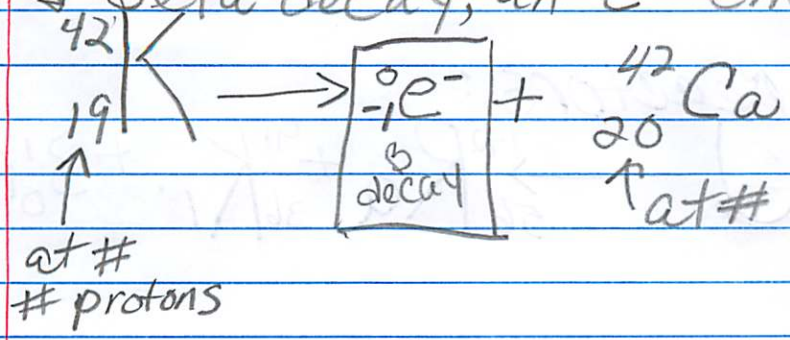
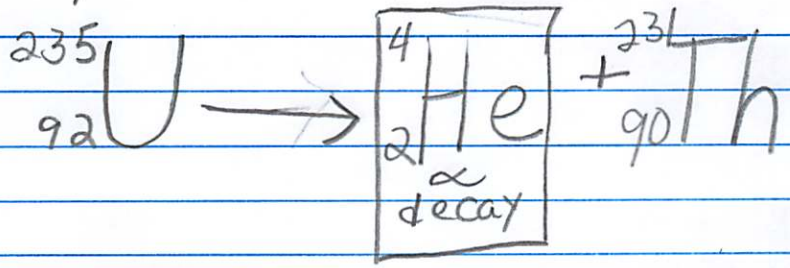
Nuclear Reactions

Numbers on both sides equal
Matter is conserved
mass # = ptn
Beta decay, an e^- emitted:

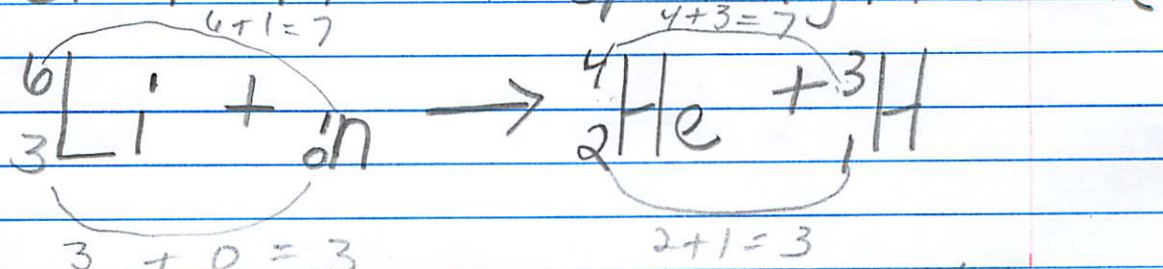


Alpha decay: Helium Nucleus = α particle



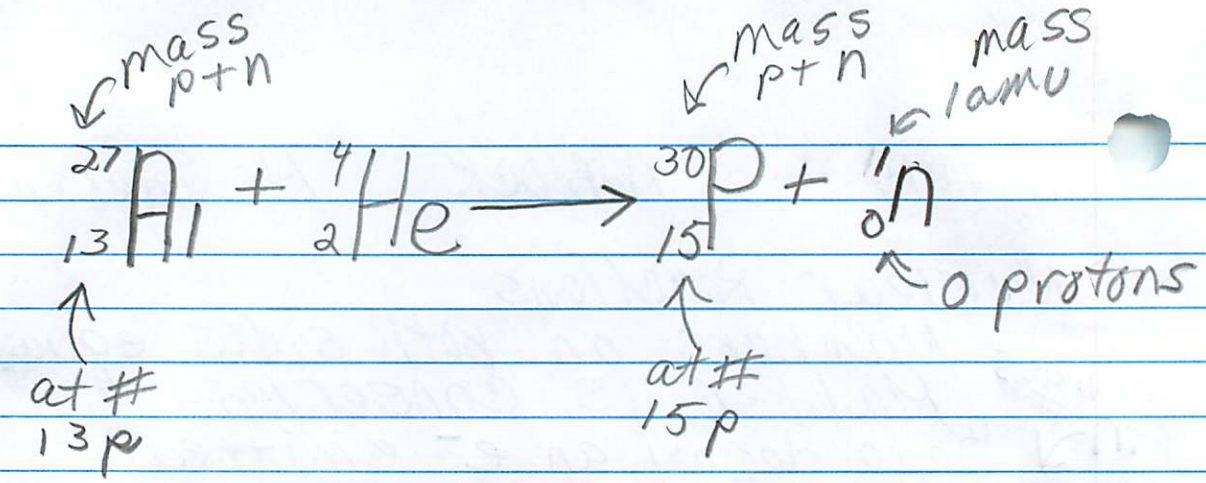
Nuclear Fusion - Happens in Stars:

Nuclear Fission - Splitting the Atom

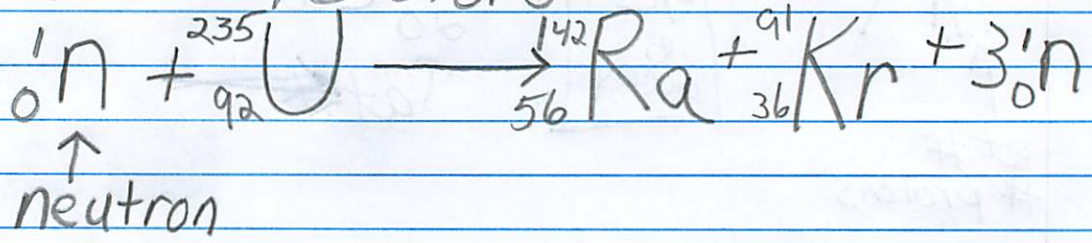


Equal numbers on both sides.

over →



Nuclear Reactors:



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HW #1, 2, 4, 6 on half-life WS

TEST- Monday 11/7 on Chap. 3

p64 Q8:

Lithium-6 7.6 %

Lithium-7 92.4 %

What is the average mass of Lithium?

$(6\text{amu})(.076) + (7\text{amu})(.924) =$

$.456 + 6.47$

$= 6.92\ \text{amu}$

β particle emission:

$^{42}_{19}K \longrightarrow {}^{0}_{-1}e^{-} + {}^{42}_{20}Ca$

(β particle)

$^{131}_{53}I \longrightarrow {}^{0}_{-1}e^{-} + {}^{131}_{54}Xe$

↑ β particle

Alpha α particle emission:

$^{175}_{78}Pt \longrightarrow {}^{4}_{2}He + {}^{171}_{76}Os$

↑ α particle

Nuclear Decay:
Half-Life - the time it takes for half of a sample to decay.
Is a Logrhythmic process
Nuclear waste - lingers forever

Half-life Problem:
A sample of ^{32}P has a half-life of 2 weeks. How much of a 80g sample will be left after 8 weeks.

8 weeks = 4 half-lives
^{32}P decayed in half 4 times

$80g \xrightarrow[1]{2wk} 40g \xrightarrow[2]{2wk} 20g \xrightarrow[3]{2wk} 10g \xrightarrow[4]{2wk} 5g$
↑ remains

A 100g sample of U decayed to 6.25g over a period of 10,000 years. What is the half-life of U?

$6.25g \xrightarrow{\times 2} 12.5g \xrightarrow{\times 2} 25g \xrightarrow{\times 2} 50g \xrightarrow{\times 2} 100g$

went through 4 half-lives over 10,000 years

$\frac{10,000}{4} = 2500$ yrs / half-life